
INSPECTION PROCEDURE 88200 APPENDIX G

INSPECTION OF ELECTRICAL CABLE AT FUEL CYCLE FACILITIES

Effective Date: May 28, 2025

88200.G-01 INSPECTION OBJECTIVES

- 01.01 To determine if safety-significant electrical cable work is being performed in accordance with regulatory requirements, the licensing basis, specifications, drawings, and work procedures.
- 01.02 To determine if the applicant/licensee's system for preparing, reviewing, and maintaining records relative to safety-significant electrical cable activities reflects work accomplishment consistent with specifications and procedures.
- 01.03 To determine if the as-built condition of safety-significant electrical cables meets the specified design requirements, specifications, and drawings. For installation of electric components and systems, refer to Appendix H of this inspection procedure (IP).
- 01.04 To determine if the implementation of the management measures related to work activities for safety-significant electrical cables associated with items relied-on for safety (IROFS) is effective and to verify that deviations from requirements are appropriately resolved.

88200.G-02 INSPECTION REQUIREMENTS

- 02.01 For the safety-significant items and services (SSIS) selected for inspection of electrical cables, determine whether procedures exist in the following areas, are compatible with the management measures program for IROFS, and prescribe adequate methods to meet the licensing basis and construction specifications, where applicable:
 - a. receipt inspection
 - b. storage and handling
 - c. installation activities
 - d. construction testing
 - e. configuration management
- 02.02 Determine whether the applicant/licensee has an established audit program (including plans, procedures, and audit schedule) for assessing the adequacy of work control functions and requirements, as applicable in their licensing basis, in the area of safety-significant electrical cable construction activities, and for ensuring that examination, inspection, and if required, test personnel associated with performing tests and inspections of safety-significant activities are qualified and/or certified to perform their assigned work.

- 02.03 Ascertain whether the following safety-significant electrical cable activities, as required by licensing commitments and applicable construction codes, are being controlled and accomplished in accordance with documents reviewed in Inspection Requirement 02.01, above:
- a. receipt inspection
 - b. storage and handling
 - c. installation activities
 - d. construction testing
 - e. configuration management
- 02.04 Review the documentation generated for the safety-significant electrical cable activities, as required by the licensing basis. Determine whether the applicant/licensee/contractor system for documenting safety-significant work is functioning in accordance with requirements. Records should be complete, reviewed by quality control, engineering personnel, or designee, as required, and readily retrievable.
- a. receipt inspection and material certification
 - b. installation inspection
 - c. nonconformance/deviation record(s)
 - d. training/qualification records of craft, and quality inspection personnel (as required)
 - e. configuration management records

88200.G-03 INSPECTION GUIDANCE

General Guidance

Inspectors should review the facility description in the integrated safety analysis, integrated safety analysis summary, or equivalent and be familiar with the SSIS being constructed at the site. The purpose of these as-built inspections is to verify that the assumptions and critical attributes reviewed during the licensing review process remain valid; the design was appropriately translated to construction specifications; the licensee/applicant constructed the facility in accordance with these specifications; and any modifications performed complies with the licensee's configuration management program and does not impact any NRC licensing decisions.

The term "cable" includes all conductors such as fiber optics wires, cables, and busbars. The term "termination" refers to all electric-conductor terminations such as lugs, splices, connectors, and terminal strips that directly contribute to the electrical continuity of the circuit. Terminations also include potheads, bushing, stress cones, taping, compounds, and other devices or techniques that directly contribute to the continuity of the electrical insulation system.

Inspectors should also be familiar with the licensee's management measures and/or quality assurance program, if applicable, and the licensing basis associated with these measures. It is not the objective of this IP to verify the adequacy of the applicant/licensee's management measures program, but inspectors should be prepared to identify potential gaps in the implementation of management measures for future inspections. Inspectors should complete this appendix by inspecting the attributes listed in this appendix for as-built electrical cable work with a focus on SSIS, such as IROFS, or regulatory requirements, as applicable. Inspectors should also coordinate this appendix with inspection of electric components and systems (Appendix H of this IP) for efficiency.

Inspectors should contact the applicant/licensee prior to the onsite inspection to help determine what samples are to be inspected. Observation during in progress activities, like construction, installation, and testing, is desirable but not required. If necessary, inspectors may select completed systems for inspection. Inspectors should not attempt to inspect all available samples but may expand if significant concerns with the applicant/licensee's control of installation/construction arise in this functional area.

Inspectors should collect applicant/licensee procedures, specifications, and work completion records in advance. If unable to review these documents in advance of the onsite inspection, then the licensee should be notified that these documents, and any other relevant documents, should be available when the inspector(s) arrives at the site.

Inspectors should choose one or more safety-significant electrical cables and review the areas listed in Inspection Requirements 02.01 through 02.04 to the extent practical and may use their judgment in determining which areas to concentrate on if time is limited.

03.01 Inspection Requirement 02.01

- a. Review construction specifications related to safety-significant electrical cables and ascertain whether the specified technical requirements conform to the commitments contained in the licensing basis.
- b. Review electrical cable procedures and as applicable, verify they specify provisions for adequate onsite engineering direction, are appropriate and adequate related to procurement and use of materials, specify adequate control of hold points, and provide adequate controls for design changes and incorporation of design changes into as-built drawings.
- c. Determine if appropriate and adequate procedures in the following areas are compatible with the management measures program, and prescribe adequate methods to meet the construction specifications, where applicable:
 1. receipt inspection
 2. storage and handling
 3. installation activities
 4. construction testing
 5. configuration management
- d. For the procedure review, consider the following attributes:
 1. Controls to ensure that the type and classification of electrical components and systems comply with approved drawings and/or specifications and meet licensee commitments.
 2. For IROFS, determine if procedures are compatible with the management measures program, and prescribe adequate methods to meet the construction specifications.

03.02 Inspection Requirement 02.02

- a. Review applicant/licensee's established audit program (including plans, procedures, and audit schedule) for assessing the adequacy of work control functions and requirements,

as applicable, in their licensing basis, in the area of safety-significant electrical cable construction activities.

- b. Review audit program to verify if examinations and inspections are performed in accordance with applicant/licensee's requirements and if test personnel associated with performing tests and inspections of safety-significant electrical cable construction activities are qualified and/or certified to perform their assigned work.
- c. Verify records establish that required audits, as applicable, were performed and that deficiencies identified during audits were tracked and corrected.

03.03 Inspection Requirement 02.03

- a. Select a sampling of safety-significant cables and may include power, control, and data cables (fiber optic, communications, coax, twisted, multi-conductor, and shielded). The sampling may also be from a variety of locations, uses and types (e.g.: large motors; diesel generators; motor-operated valves; solenoid valves; control centers; control room panels and cabinets; local panels and cabinets; coaxial and triaxial connectors; fiber optic connectors; and stress-cone terminations).
- b. Ascertain whether the following activities, as required by licensing commitments and applicable construction codes, are being controlled and accomplished in accordance with the requirements of the documents reviewed in 02.01, above:
 - 1. Receipt Inspection. Evaluate portions of receipt inspection activities pertaining to the electric power, control, data cables and associated items selected for inspection.
 - (a) Determine whether receipt inspection activities are being controlled and performed in accordance with the licensee's commitments and procedures. Receipt inspections may include the following:
 - (1) Components and receiving documents are properly identified.
 - (2) Physical conditions (damage, deterioration, etc.) are documented.
 - (3) Documentation related to management measure requirements (e.g., results of functional and qualification testing) received with cables and associated items is reviewed and meets the requirements. Where qualification testing of cables and associated items to be placed in a harsh environment is not a requirement of the specification, determine what means will be used to ensure that applicable environmental qualification will be satisfied.
 - (4) Control of nonconforming cables and associated items is conducted in accordance with applicable procedures and meets requirements.
 - (5) Adequately, qualified personnel are available to perform the receipt inspection function.
 - (b) Received components are as specified, properly identified, and controlled or otherwise noted.
 - (c) Verify procurement requirements, as applicable, such as qualification tests, certificate of conformance, functional tests and other quality tests (material,

physical, and chemical) have been successfully completed or status of how and when such requirements will be satisfied is documented and adequately controlled. Fire barriers and cable-penetration seals may require qualification. The tests and criteria may reference the American Society of Testing and Materials (ASTM) E 814 and/or American National Standards Institute/Underwriters Laboratory Inc. (ANSI/UL 1479). Refer to the applicant/licensee's licensing basis for tests and criteria requirements.

2. Storage and Handling. Special storage requirements are typically specified by the manufacturer or an industry standard, committed to by the licensee. The requirements should include such things as taping or sealing cable ends, controlling material and cable or cable reel identification, maintaining proper ambient temperature, separation from nonconforming items, and placement on dunnage.

(a) Observe and evaluate, as applicable, storage activities and conditions for the selected components. Determine whether:

- (1) Electric power, control, data cables and associated items are stored in the proper storage level designation.
- (2) Cables, busways, and associated items are properly identified.
- (3) Storage conditions (temperature, humidity, cleanliness, etc.) and requirements are controlled and monitored as directed by the applicable procedures and by the manufacturer's specifications.
- (4) Licensee and contractor inspection and monitoring activities are being performed in accordance with procedural requirements.
- (5) Nonconforming cables and associated items placed in storage are identified and/or segregated as required.
- (6) In-place storage requirements are satisfied.
- (7) Adequately qualified personnel are available to perform the required storage functions.

3. Installation Activities.

(a) In-Process Installation. If installation is in progress during the inspection, evaluate in-process installation to determine if the licensee is following their procedures pertaining to the components and associated items selected in the appropriate subsections of Inspection Requirement 02.01. Inspect a sampling of the following attributes:

- (1) The latest approved revision of applicable construction specifications, drawings, and/or construction procedures are available and used by the installers. (Verify later that pull card data are consistent with the latest cable tabulation sheets.)
- (2) Cables, busways, associated materials, and pulling compounds are as specified.

- (3) Pulling attachments and tensions used are acceptable.
- (4) Cable temperature is acceptable before handling and installation.
- (5) Raceway completion and condition are adequate before cable is installed.
- (6) Cables are protected from sharp edges, hostile environments, and adjacent construction activities (especially welding and cutting activities).
- (7) Cable routing is correct.
- (8) Separation criteria for physical independence are maintained.
- (9) Segregation is maintained (e.g., power, control, and instrument).
- (10) Cable identification is preserved.
- (11) Proper bending radius is maintained (during and after installation).
- (12) Less than maximum tensile force is applied for pulling based on cable tensile rating.
- (13) Cable and other conductor supports are provided.
- (14) Cable entry to terminal point is acceptable.
- (15) Shields are grounded per construction drawings and specifications.
- (16) Torque wrenches and crimping tools are in proper working order and properly calibrated.
- (17) Jumpers are controlled.
- (18) Terminations are of the correct type and properly located.
- (19) Shield terminations for instrumentation and controls cables are installed in accordance with the appropriate detail drawing requirements, using the appropriate lead connections.
- (20) Shields for cables rated 5KV and above are terminated with appropriate materials, including voltage stress relief devices that do not compromise the integrity of the cable's shield or insulation system, in accordance with project design standards.
- (21) All cable shields are grounded appropriately per the project document requirements.
- (22) Tightness of connections is acceptable.
- (23) Appropriate scaffolding, walkways, and climbing aids are used in lieu of cable trays, conduits, etc.

- (24) Cabinets, control centers, cable trays, junction boxes, etc. are maintained free of debris (periodically cleaned).
 - (25) Coiled cables are properly secured (i.e., not draped from cable trays, lying on floor, coil supported by single tie wire, etc.).
 - (26) Un-terminated cable ends or un-terminated instrument cable shielding are properly protected (i.e., moisture protection), if required.
 - (27) Specified fire barriers, compartment boundary seals, and fire-retardant materials are being installed or applied, where specified.
 - (28) Electricians are properly qualified.
 - (29) Quality Control inspectors are properly qualified and are present and performing their assigned tasks, when required, during handling and installation activities.
 - (30) Nonconformances are identified and handled in accordance with procedures, including adequate justification for use-as-is disposition.
 - (31) Installation and inspection activities are being documented during the activity.
- (b) Completed Work. Evaluate the completed installation of cables and associated selected items and compare completed configuration with procedures, construction specifications, etc., as applicable:
- (1) Busway, cable, wire, and termination materials (lugs, tapes, stress cones, splice kits, connectors, terminal blocks, etc.) are as specified.
 - (2) Cable routing is as specified on latest approved drawings.
 - (3) Cable identification is preserved and located where specified.
 - (4) Bending radius is as required.
 - (5) Required separation criteria for physical independence are maintained.
 - (6) Segregation is maintained (power, control, and instrument).
 - (7) There is no evidence of damage to cable.
 - (8) Terminations are properly located and made (entry, tightness, etc.) and are of the correct type.
 - (9) Cable supports are provided and are adequate.
 - (10) Cables are protected from sharp edges, hostile environments, and adjacent construction activities (welding, etc.).
 - (11) Cable tray, conduit, etc. are adequately protected and not being used as ladders, walkways, etc.

- (12) Clearances between cable and adjacent components such as piping, ducts, and supports are as specified.
 - (13) Cabinets, panels, cable trays, junction boxes, etc. are maintained free of debris (periodically cleaned).
 - (14) Specified fire barriers, compartment boundary seals and fire-retardant materials are installed or applied, where required.
 - (15) Specified inspections are made by qualified personnel.
 - (16) Documentation of completed installation and inspection activities is properly completed, in a timely manner.
 - (17) Nonconforming conditions are identified and handled in accordance with approved procedures, including adequate justification for use-as-is disposition.
 - (18) Conductive grease and electrical contact lubricant (NO-OX-ID) has been applied to power connectors as required by construction drawings and specifications.
- (c) As-Built Verification. When electrical power, control, and data cables, and associated items, as selected in appropriate subsections of Section 02.01, are completely (or essentially) installed and inspected, the latest revisions (as-built, if available) of installation drawings pertaining to the cables and items selected for verification. Review construction specifications and other applicable work instructions referenced by the drawings. Compare the actual installation with the above drawings and associated documents.
- (1) Before performing the above, verify the number and status of outstanding design changes on the selected drawings and related specifications.
 - (2) Discrepancies observed may result from in-process changes, such as those initiated in the field. If in-process changes are involved, determine whether the licensee has properly controlled and documented these changes for engineering review, approval, and subsequent incorporation into the final as-built drawings.

4. Construction Testing.

- (a) If possible, observe a sampling of the following cable-testing activities applicable for the sample selected in the appropriate subsections of Section 02.01:
 - (1) High potential tests on high-voltage power cables and 4160-volt cables.
 - (2) Insulation resistance tests.
 - (3) Continuity tests.
 - (4) Connection resistance testing on DC battery connectors.

- (5) Fiber optic cable-testing, including acceptance testing prior to installation, pre-installation continuity test, and post-installation continuity test.
- (b) Determine whether the following requirements are being met for the above tests (as applicable):
 - (1) Use of and compliance with the proper procedure.
 - (2) Calibration of the test equipment is current and test personnel qualified to use the equipment.
 - (3) Results are properly and accurately recorded.
 - (4) Test results are within specifications limits or discrepancies are identified for resolution.
- 5. Configuration Management. For the activities observed during Inspection Requirement 02.03., verify if changes occurred during these construction activities, the applicant/licensee properly controlled and documented these changes for engineering review, approval, and subsequent incorporation into the final as-built drawings, as applicable. Verify these actions were completed in accordance with their procedures and management measures.

03.04 Inspection Requirement 02.04

Ascertain whether for the safety-significant electrical cable construction activities, the applicant/licensee/contractor system for documenting safety-significant work is functioning in accordance with requirements.

- a. Receipt Inspection and Material Certification. Select records applicable to the receipt of lots or shipments. Select records applicable to the storage, and storage inspection of lots or groups of electrical cables and associated items.
 - 1. Records confirm that required material characteristics, performance tests, environmental qualification tests, and other specification requirements are met, as required.
 - 2. Receipt inspection and storage records indicate that, where appropriate, defective or incorrect components, parts, and materials are controlled and prevented from installation and possible use.
 - 3. Documentation has been prepared and maintained as required by receipt inspection and documentation storage instructions.
- b. Installation Inspection.
 - 1. Records confirm that specified materials and components were installed as specified and that the required construction inspections were performed, and acceptance criteria are defined. A sample selection should include installation records, cable-testing records, and raceway loading records.
 - 2. Review licensee and contractor requirements covering the span of records for electrical cables. Determine the initiation point for those records sampled and,

importantly, the effectiveness of those responsible for reviewing the records for accuracy and completeness and ensuring that the recorded information meets documentation requirements. To determine the effectiveness of the licensee or contractor system for documenting work in this area, verify that:

- (a) various safety related power, control, signal, data and instrument cables (including thermocouple wire)
 - (b) cable connectors, splices, and support grips
 - (c) terminations, lugs, NO-OX-ID compound tapes, and pulling compounds
 - (d) fire barriers, seals and retardants
3. Review and evaluate pertinent quality records in a sampling of the areas listed below. Determine whether:
- (a) Adequate preparation, control, review, and evaluation of these records have been made.
 - (b) Records reflect that appropriate requirements have been met.
 - (c) The system of records is functioning properly.

c. Nonconformance/Deviation Record(s)

- 1. Records include current status of these items. Nonconformance reports include the status of corrective action or resolution, (e.g., determine whether adequate corrective action is being taken when test results are not within tolerance or acceptance criteria.)
- 2. For the inspection, review and evaluate a sampling of reports applicable to nonconformances or deviations. Determine whether:
 - (a) Records are complete and promptly reviewed by qualified personnel.
 - (b) Records have been routinely processed, evaluated in a timely manner and controlled through established channels, for resolution of the root-cause as well as the immediate problem.
 - (c) Records are properly identified and stored, indicate current status, and can be retrieved in a reasonable time.
 - (d) Nonconformance reports include the status of corrective action or resolution, and adequate justification is provided for use-as-is disposition.

d. Training/Qualification Records of Craft, and Quality Inspection Personnel. Records establish that quality inspection personnel, as applicable, are adequately qualified for their assigned duties and responsibilities and that craft personnel have been trained in their assigned tasks. Records are complete and current and show which activities inspectors are qualified to perform.

- e. Configuration Management Records. Review and evaluate a selected sample of configuration management records, and determine whether:
 - 1. Records associated with design and field changes, as well as related work and IP changes, reflect that timely review and evaluation of design and field change documents have been performed by personnel who are qualified.
 - 2. Records of periodic inspections ensure that only the most recent approved documents, including design changes, were used in the field.
 - 3. Design changes are subject to adequate design control, including consideration of the impact of the change on the overall design and on as-built records.
 - 4. Records of nonconformance's to design requirements include preparation of a nonconformance report even if the nonconformance is resolved through the design-change process.

03.05 Additional Guidance

Note: Personnel Interviews. Informal interviews with field-craft and inspection personnel may be randomly conducted to determine how well employees know the requirements of their work activity. Ascertain whether a sufficient number of adequately qualified quality control inspection personnel, if required, are at the construction site, commensurate with the work in progress, and adequately performing their assigned duties through the established organizational structure.

Prevalent Errors and Concerns. Areas in which the inspector should be alert to potential generic issues. This section is included to provide background for inspectors on past electrical cables issues related to construction experience at previous projects. (Note: These are not listed in order of their perceived importance to safety.)

- a. Adequate procedures or other means have not been established to assure and document that all safety-significant (and if applicable, IROFS or risk significant structures, systems, and components systems have met applicable criteria, or to specifically document non-conformances).
- b. IPs do not include adequate inspection requirements and acceptance criteria.
- c. Inadequate means to control location and status of electric cable and components, especially during removal for repair or replacement.
- d. Inadequate procedures to control the evaluation, approval and use of field changes. (The licensee or contractor also should establish means to assure that only the latest approved field changes and other revisions or changes are being used for installation and inspection activities.)

88200.G-04 RESOURCE ESTIMATE

This appendix is intended to provide inspection requirements and guidance applicable to a wide variety of potential construction projects at both existing and new fuel cycle facilities (FCFs). These projects may vary greatly in scope, complexity, and potential risk to public health and safety. Recommended inspection scope and hours for a specific new FCF will be documented

in the principal inspection plan (PIP) for that facility developed in accordance with Inspection Manual Chapter (IMC) 2694, "Fuel Cycle Facility Construction and Pre-Operational Readiness Review Inspection Program."

Additionally, this IP can be used to provide additional inspection guidance for plant modification inspections at existing facilities but is not required to be implemented for these projects. Use of this appendix, or sections of this appendix, for modifications at existing FCFs, would be done on a case-by-case basis, in accordance with IMC 2600, Appendix B, "NRC Core Inspection Requirements."

88200.G-05 PROCEDURE COMPLETION

This IP is complete when the applicable appendices or applicable appendix sections are completed for the facility, as determined by the PIP. Inspectors are not expected to complete every activity in the appendices of this IP. Instead, inspectors should prioritize inspection activities based on 1) importance of the activity to safety, 2) availability of the onsite activity at the time of the inspection, and 3) available inspection resources. This appendix does not need to be completed if there are no SSIS covered by this appendix at a FCF.

88200.G-06 REFERENCES

Refer to licensing basis requirements for applicable codes and standards for each fuel facility.

ASTM E 814 and ANSI/UL 1479.

END

List of Attachments:

Attachment 1: Revision History Table

Attachment 1: Revision History for IP 88200 Appendix G

Commitment Tracking Number	Accession Number Issue Date Change Notice	Description of Change	Description of Training Required and Completion Date	Comment Resolution and Closed Feedback Form Accession Number (Pre-Decisional Non-Public Information)
	ML24215A338 05/28/25 CN 25-014	Initial issuance. Discipline specific appendix developed to provide technical inspection guidance for new construction and major modifications activities for fuel facilities with varying technologies, size, licensing requirements, etc.	N/A	N/A